THE ZE5JJ EME ANTENNA

DIVISION OF VARIAN
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S49-23

4162

A 32FT PARABOLIC DISH ANTENNA FOR EME & RADIO ASTRONOMY

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The antenna at ZE5JJ has been in operation since February 1977. Successful QSO's have been made with thirty-six stations to date and the total number of QSO's is rapidly approaching the century.

Since it is possible that others may wish to build an antenna along similar lines, the following information with photographs, it is hoped, may be of assistance.

OESIGN PHILOSOPHY

The primary objective was to construct a dish to be light in weight and yet adequately strong. It had, of necessity, to be made by one man in a backyard using locally available materials and minimal workshop support. Bearing in mind that in this part of Africa, snow is unheard of, icing only occurs with ground frost and winds, though usually gusty, seldom exceed 50 knots, it was possible to fulfill the basic design requirements. As there are antenna feeds already developed for dishes with f/O ratios around 0.5 - 0.6, for this design an f/D ratio of 0.55 was chosen. The equation $y^2 = 4fx$ enabled the parabolic profile to be generated and subsequently transferred to a large steel jig for truss fabrication. The diameter O of thirty-two feet was dictated by the maximum length of aluminium tube available.

CONSTRUCTION

Essentially a method proposed by VK3ATN was followed whereby component parts of the structure are joined together with aluminium gusset plates and numerous pop-rivets. Eighteen trusses were preformed and fabricated in this manner in the jig and then bolted onto a central hub. Two large diameter tubular rings were integrated into the trusses so as to form, along with numerous vertical struts and angular ties, a rigid frame somewhat resembling a kettle drum. The mating ring (4" x 4" x ¼" steel) attached to the mount, was secured onto the rear of the structure with eighteen 5/16" diameter cadmium plated bolts which pass through vertical struts. Angular ties between these vertical struts and the top ring of the drum were fitted to the trusses to give added strength. Tube 1" diameter, 1.5mm wall thickness, was used throughout for the main structure and tube 3/8" diameter, 1.5mm wall thickness was utilized for the internal surface support rings.

Where portions of rings were joined suitable tube or solid rod was pre-bent before insertion. Galvanized iron netting half-inch diameter hole size - was tied down onto the surface rings with pvc covered wire. The surface is made up of a central circular panel, six rectangular and six triangular panels which were joined along their seams at half-inch intervals and soldered at one inch intervals. The final tightening up of the netting, to be rid of bumps and bulges, was carried out by judiciously squeezing the half-inch diameter holes together with ROUND nosed pliers. Though time consuming this resulted in a taut, clean surface lying well within the design tolerance of half-inch.

Corrosion due to contact potential and galvanic action in the presence of moisture between dissimilar metals received careful attention. In consequence aluminium rivets, cadmium plated steel screws, studs and nuts were mandatory. Surface rings where the galvanized iron netting could touch aluminium tube were protected by the application of five coats of paint - two zinc chromate, two epoxy resin, one aluminium.

Curved members of the trusses were pre-bent in a modified form of VK3ATN's rolling mill so that minimal pressure was necessary to force each into the true parabolic shape prior to riveting.

432MHz FEED AND SUPPORT

The original EIA feed, modified by K3BPP, was built, which comprises two sets of dipoles fed in phase, placed orthogonally and mounted $\lambda/4$ above a 1λ square reflector.

Three three-inch diameter aluminium tubes formed the tripod supporting the feed. A triangular frame positioned near the apex enables the feed to be moved into or out of the dish and the dipole plane was set at the measured focal distance.

MOUNT

An ALT/AZ mount was chosen to give maximum coverage and ease of construction. The AZ axis is attached to a rotatable steel plate three feet in diameter onto which the ALT axis is itself affixed. The plate is supported by eight upturned sealed ball races whose positions are carefully set such that each race shares equal vertical loading. Both axes are controlled by 24 volt DC reversible motors which drive 625:1 gear boxes, 6:1 chain reductions, and finally 25:1 heavy duty worm gears. Tracking speed is fixed at 1^{o} in four seconds. Mechanical bias was applied to the ALT axis such that the counter weights always tend to restore the antenna to its ZENITH rest position.

TOWER

A square section, three feet wide, lattice steel tower of rigid construction was fabricated in two sections of four feet and fourteen feet long. Since it was essential to be able to build the entire mount with its complication of motors, drives, synchros, limit switches, junction boxes etc., at ground level, a very short top section of tower was obligatory. Final alignment of the axes in the vertical and horizontal planes was carried out by adjustment of the coupling bolts holding the two sections of tower together. By fitting double nuts on each of the eight coupling bolts between the two tower sections, fine adjustments were possible.

RESULTS

Initial results, when compared with those obtained from the one hundred and twenty-eight element collinear, were very different and most encouraging. More recent results after fitting an NE24406 GaAS FET Preamplifier have yielded Sun Noise averaging 17-18 dB above cold sky. The cold sky below 50 ohm termination has been repetitively measured down to minus 4.5 dB. With 750 watts input to the dish, the echo level, depending on the Faraday Rotation, has been observed in excess of 12 dB on peaks.

Generally, moonbounce has become an exciting and rewarding pursuit instead of one of considerable frustration. One can derive much enjoyment from just monitoring moon echoes. Distant celestial noise sources have been positively identified with good results and a Sun noise derived profile of the antenna's major lobe shows it to be 4^{o} wide at the half power points. Clearly the results justify the expense and months of toil.

ACKNOWLEDGEMENTS

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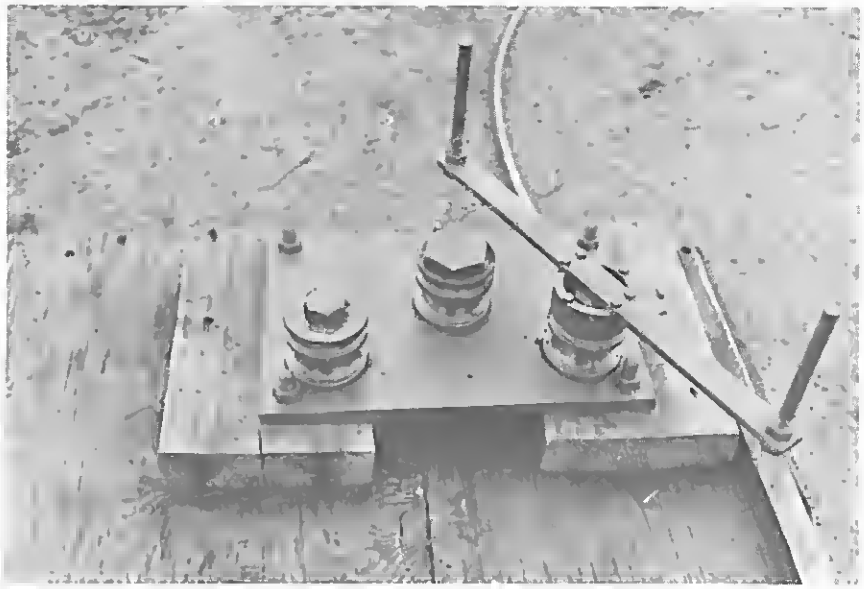
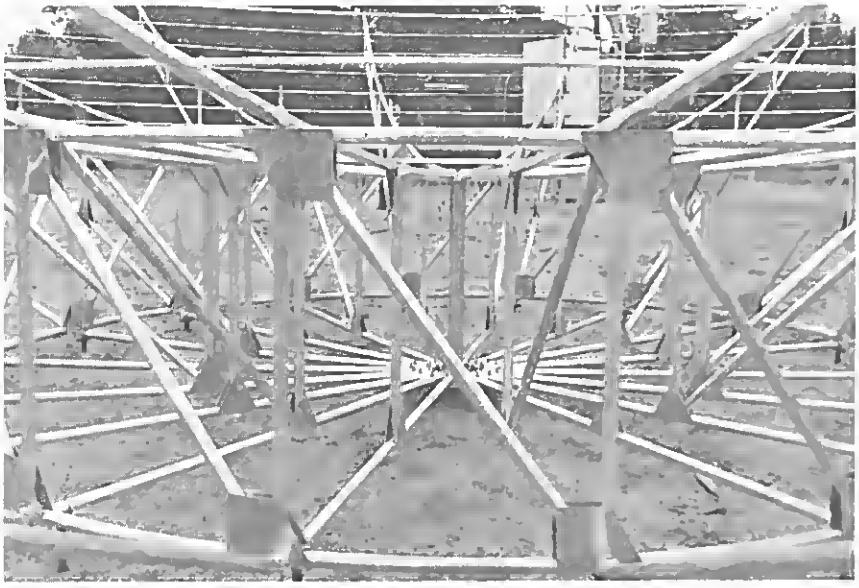
Ray Naughton, VK3ATN - for his advice and the information published in HAM RADIO, May 1974 "Parabolic Reflector Antennas".

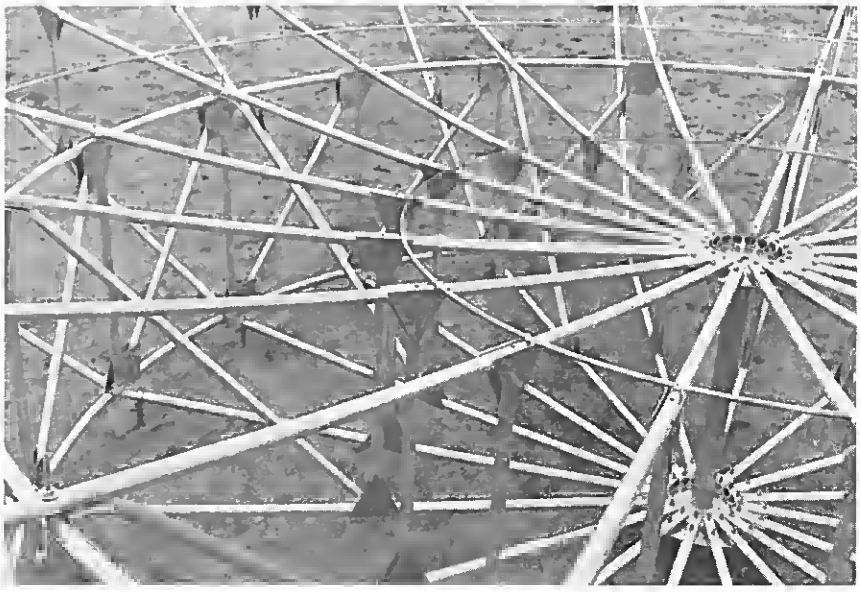
Modified VK3ATN Rolling Mill.



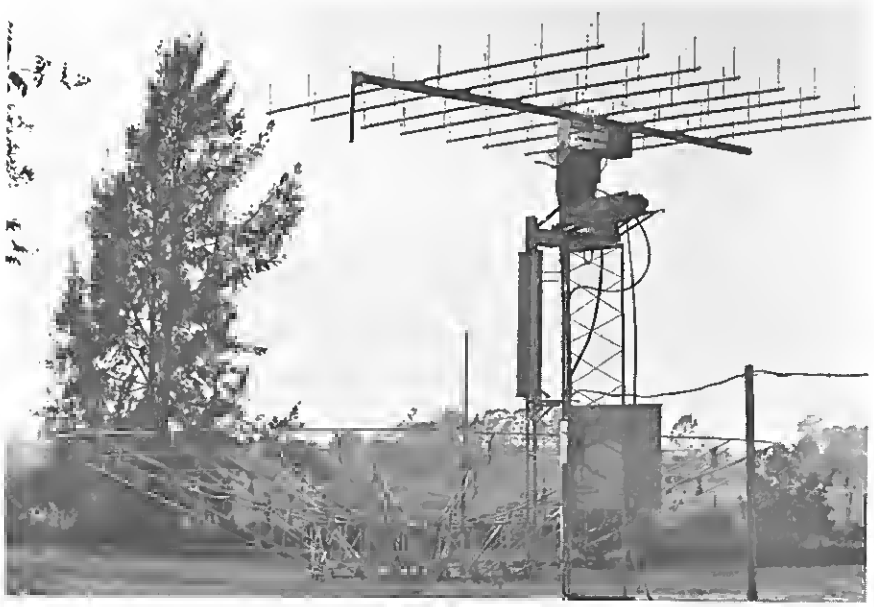


Structure showing drum, central hub and gusset pleats.

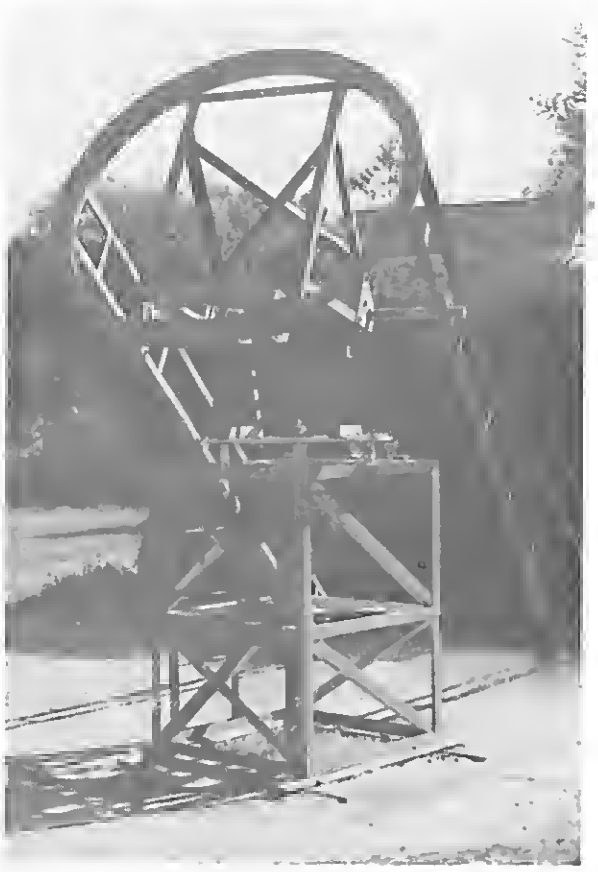
Structure from above showing angular and vertical ties and struts.



Completed structure from above before fitting of netting.



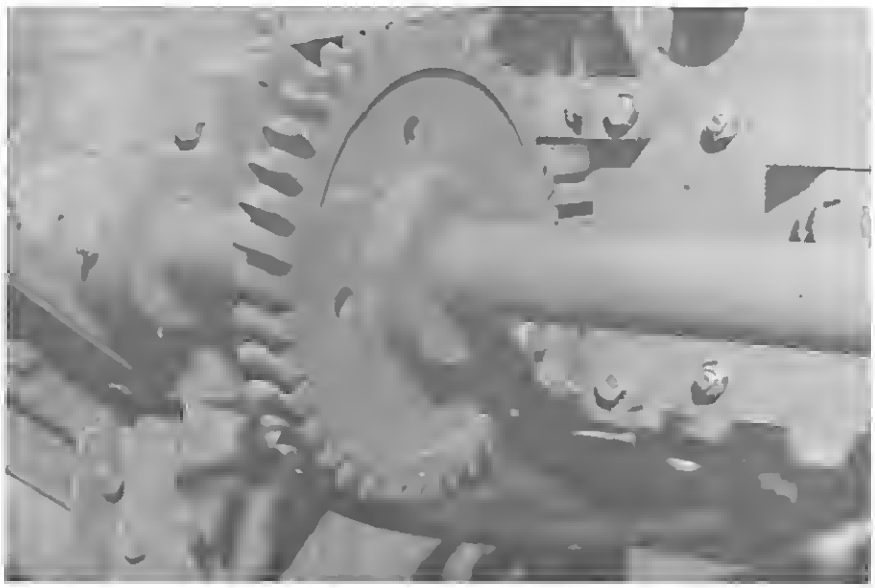
The OLD and the NEW - in early morning mist.



Construction of the mount.

AX axis worm drive, rotary turntable and upturned ball races.

Closeup view of ball races and AZ turntable.



ALT axis worm drive.

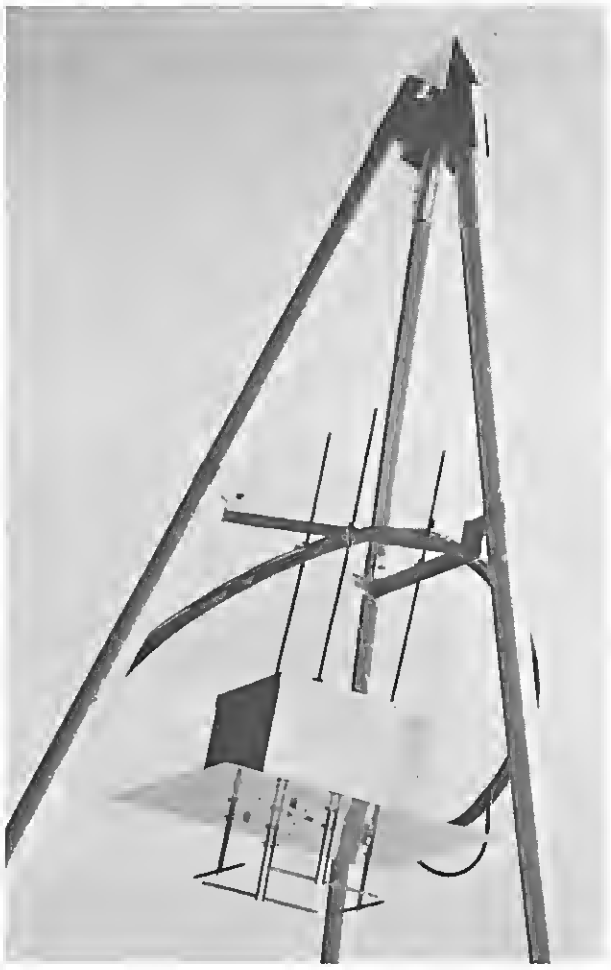
14ft. tower section in position with 4ft. section about to be coupled.

Two tower sections being joined. Mating ring and ALT axis shaft in foreground.

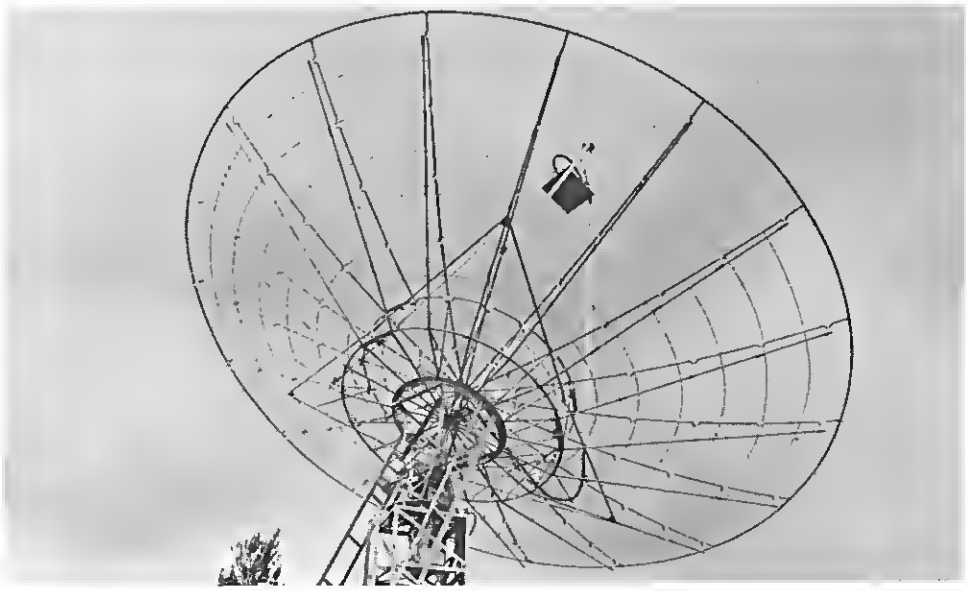
Mating ring assembly integrated with mount.

Dish airborne preparatory to attachment to the mating ring.

Dish coming into position for mating.



Apex of tripod and K3BPP dual polarized feed.



Rear view of dish and top portion of mount.

Front oblique view of complete antenna.

Rear view of complete antenna - note pendulum counter weights.